Claims

1. A catadioptric projection lens, in particular for use in a microlithographic projection-exposure apparatus, for imaging in an image plane an object arranged in an object plane, comprising

   a) a catadioptric part including a plurality of refractive optical elements through which the light rays pass twice and an imaging mirror;

   b) a dioptric part adjacent to the image plane which includes a plurality of exclusively refractive optical elements;

   c) a beam-deflecting arrangement which guides the light rays issuing from an object point located in the object plane into the catadioptric part and a polarisation-sensitive reflective layer,

   characterised in that

   d) at least some of the refractive optical elements in the catadioptric part (5) and in the dioptric part (18) adjacent to the image plane (3) consist of a material which has intrinsic birefringence,

   e) through selection of the crystallographic orientation of the material and/or of the material and/or of the compensation coatings for at least some of the birefringent refractive optical elements, the disturbing part of the

intrinsic birefringence is at least partially reduced,

f) the catadioptric part (5) and the dioptric part (18) being compensated separately from one another with respect to intrinsic birefringence.

2. Catadioptric projection lens according to Claim 1, having a dioptric part adjacent to the object plane, characterised in that the dioptric part (4) adjacent to the object plane (2) is compensated separately from the catadioptric part (5) and from the dioptric part (18) adjacent to the image plane (3) with respect to intrinsic birefringence.

3. Catadioptric projection lens according to Claim 1, having a dioptric part adjacent to the object plane, characterised in that the dioptric part (4) adjacent to the object plane (2) and the catadioptric part (5) are compensated jointly but separately from the dioptric part (18) adjacent to the image plane (3) with respect to intrinsic birefringence.

4. Catadioptric projection lens according to any one of the preceding claims, characterised in that the birefringent refractive optical elements consist of fluoride, in particular calcium or barium fluoride.

5. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (110) direction, the [1-10] direction of the first lens (15) including an angle of

0°, and the [1-10] direction of the second lens (16) an angle of 90°, with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

6. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (110) direction, the [1-10] direction of the first lens (15) including an angle of 90°, and the [1-10] direction of the second lens (16) an angle of 0°, with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

7. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (111) direction, the [1-10] direction of the first lens (15) including an angle of 0°, and the [1-10] direction of the second lens (16) an angle of 60°, with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

8. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (111) direction, the [1-10] direction of the first lens (15) including an angle of 30°, and the [1-10] direction of the second lens (16) an angle of 90°, with a reference direction which is

disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

9. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (100) direction, the [010] direction of the first lens (15) including an angle of 0°, and the [010] direction of the second lens (16) an angle of 45°, with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

10. Catadioptric projection lens according to Claim 4, characterised in that the catadioptric part (5) contains two lenses (15, 16) the axes of which are disposed parallel to the (100) direction, the [010] direction of the first lens (15) including an angle of 45°, and the [010] direction of the second lens (16) an angle of 90°, with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

11. Catadioptric projection lens according to any one of claims are 4 to 10, characterised in that the catadioptric part (5) contains a further lens (13) the axis of which is disposed parallel to the (100) direction, the [010] direction of the further lens (13) including an angle of 0° with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

12. Catadioptric projection lens according to any one of claims are 4 to 10, characterised in that the catadioptric part (5) contains a further lens (13) the axis of which is disposed parallel to the (100) direction, the [010] direction of the further lens (13) including an angle of 45° with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

13. Catadioptric projection lens according to any one of claims are 4 to 10, characterised in that the catadioptric part (5) contains a further lens (13) the axis of which is disposed parallel to the (111) direction, the [1-10] direction of the further lens (13) including an angle of 30° with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

14. Catadioptric projection lens according to any one of claims are 4 to 10, characterised in that the catadioptric part (5) contains a further lens (13) the axis of which is disposed parallel to the (111) direction, the [1-10] direction of the further lens (13) including an angle of 90° with a reference direction which is disposed perpendicularly to the plane of projection of the Figure and is oriented towards the viewer.

15. Catadioptric projection lens according to any one of the preceding claims, characterised in that in the

refractive optical elements (8, 9) of the dioptric part (4) adjacent to the object plane (2) the (100) direction is disposed parallel to the optical axis (11).

16. Catadioptric projection lens according to any one of the preceding claims, characterised in that the beam-deflecting arrangement (7) consists of two prisms (7a, 7b) of birefringent material, in particular fluoride, between which a polarisation-sensitive beam-splitting layer (10) is arranged as a reflective layer.

17. Catadioptric projection lens according to Claim 16, characterised in that in the prism (7a) facing towards the catadioptric part (5) the (100) direction is disposed parallel to the optical axis (12) of the catadioptric part (5).

18. Catadioptric projection lens according to Claim 16, characterised in that in the prism (7a) facing towards the catadioptric part (5) a (100) direction includes with the optical axis (11) of the lens part (4) adjacent to the object plane (2) the same angle as that which a (100) direction includes with the optical axis (12) of the catadioptric part (5).

19. Catadioptric projection lens according to any one of claims 16 to 18, characterised in that in the prism (7b) which faces towards the dioptric part (18) adjacent to the image plane (3) the (100) direction is disposed parallel to the optical axis of the catadioptric part (5).

20. A method for compensating the intrinsic birefringence in a projection lens, in particular for a microlithographic projection-exposure apparatus, which comprises

a) a catadioptric part including a plurality of refractive optical elements through which the light source passes twice and an imaging mirror;

b) a dioptric part adjacent to the image plane which includes a plurality of exclusively refractive optical elements;

c) a beam-deflecting arrangement which guides the light rays issuing from an object point located in the object plane into the catadioptric part and a polarisation-sensitive reflective layer,

characterised in that

e) the disturbing influence of the intrinsic birefringence is reduced by selection of the crystallographic orientation of the material and/or of the material and/or of the compensation coatings in at least some of the birefringent refractive optical elements in the dioptric part (18) adjacent to the image plane (3), separately from the catadioptric part (5).

21. Method according to Claim 20, in which the projection lens additionally includes a dioptric part adjacent to the object plane, characterised in that the dioptric

part (4) adjacent to the object plane (2) is compensated separately from the catadioptric part (5) and from the dioptric part (18) adjacent to the image plane (3) with respect to intrinsic birefringence.

22. Method according to Claim 20, in which the projection lens additionally includes a dioptric part adjacent to the object plane, characterised in that the dioptric part (4) adjacent to the object plane (2) and the catadioptric part (5) are compensated jointly but separately from the dioptric part (18) adjacent to the image plane (3) with respect to intrinsic birefringence.